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Palatalization and Umlaut in Korean

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It has been reported in the literature on Korean phonology (Ahn 1986, Iverson 1993 and Iverson & Wheeler 1988) that coronal consonants (/s/, /n/ and /l/) excluding /t/ and palatal /c/, undergo (allophonic) secondary palatalization before a high front vocoid. On the other hand, it has also been reported that /t/ undergoes (phonemic) primary palatalization to [c] at a suffixal or clitic boundary without undergoing secondary palatalization. It was observed by Ahn, Iverson and others that /t/ before tautomorphemic /i/ undergoes neither primary nor secondary palatalization. Contrary to this observation, Kiparsky 1993 reports for Korean that underlying /c/ and /t/ undergo secondary palatalization and the /c/ which is derived from /t/ at a suffixal and clitic boundary also undergoes secondary palatalization. Based on this newer observation, we provide analyses of primary and secondary palatalization in Native Korean in the framework of OT. We will further show that Umlaut, which has been analyzed in Hume 1990, is identified as secondary palatalization.

1. Native Korean Palatalization and Kiparsky 1993

In the literature on Korean phonology (Ahn 1986, Iverson 1993 and Iverson & Wheeler 1988), it is reported that /t, t^h/ undergo (neutralizing) primary palatalization to [c, c^h], respectively, before a high front vocoid-initial suffix or clitic environment. Note in the data below that the derived /c/ and /c^h/ also undergo secondary palatalization:

(1) /t/-palatalization

a.	/mat-i/	mac^j-i	'the oldest son' ('oldest' 'NOML')
b.	/kut-i/	kuc^j-i	'stubbornly' ('to be firm' 'ADVL')
cf.	/kut-ə/	kut-ə	'become hard-Cont' ('to be firm' 'Cont')
c.	/pat^h-i/	pac^{jh}-i	'field-Nom'
cf.	/pat^h-ɨl/	pat^h-ɨl	'field-Acc'
d.	/kat^h-i/	kac^{jh}-i	'together' ('to be same' 'ADVL')
cf.	/kat^h-a/	kat^h-a	'be same-Cont'

e. /put^{h}-i/ puc^{jh}-i 'to make something stick to'
('to stick to' 'Caus')
cf. /put^{h}-ə/ put^{h}-ə 'to be sticked-Cont'

Phonemic /t/-palatalization takes place only at a morpheme boundary where a suffix or a clitic is attached to a preceding Root (Ahn 1986, Iverson 1993, Cho & Sells 1991, H. S. Kim 1982, Y. S. Kang 1991 and S.-H. Han 1991). However, previous researchers ignored the fact that the phonemically palatalized [c] is realized as secondarily palatalized [c^{j}]: namely, /t/ becomes [c^{j}], undergoing phonemic primary palatalization and allophonic secondary palatalization (Kiparsky 1993 for Korean).

When we consider the data below, we can observe that underlying /c, c^{h}/ also automatically undergo allophonic secondary palatalization before a high front vocoid, as shown in (2a):

(2) a. /kac^{h}i/ kac^{jh}i 'value'
/cəc-i/ cəc^{j}-i 'milk-Nom'
b. /ca/ ca 'ruler'
/cəc-ɨl/ cəc-ɨl 'milk-Acc'

The underapplication of primary /t/-palatalization, however, is observed morpheme-internally, as shown in (3), in which /t/ is realized as secondarily palatalized [t^{j}] before /i/ within a morpheme: no phonemic primary /t/-palatalization to [c] but only secondary allophonic palatalization is seen.

(3) Lack of phonemic primary /t/-palatalization in a non-derived environment
a. /mati/ mat^{j}i 'a knot'
b. /puti/ put^{j}i 'please'
c. /t^{h}i/ t^{jh}i 'a mote'
d. /pət^{h}i-/ pət^{jh}i- 'to withstand'
e. /panti/ pant^{j}i 'firefly'
f. /canti/ cant^{j}i 'lawn'

Korean has other types of palatalization in addition to phonemic primary /t/-palatalization and allophonic secondary /t/- and /c/-palatalization: allophonic secondary /s/-, /n/- and /l/-palatalization, which were analyzed as

postlexical phenomena in Lexical Phonology (Ahn 1985, Cho & Sells 1991, H. S. Kim 1982, Y. S. Kang 1991 and S.-H. Han 1991).

(4) Allophonic /s/-, /n/-, /l/-palatalization (S. Lee 1994: 73, S.-H. Han 1991: 66 and K.-M. Lee 1972)

a.	/os-i/	os^{j}-i	'clothes-Nom'
b.	/si/	s^{j}i	'poem'
c.	/si-kan/	s^{j}i-kan	'time'
d.	/po-si-əs-ta/	po-s^{j}y-ət-t'a	'see-Hon-Pst-Mood'
e.	/mun-i/	mun^{j}-i	'door-Nom'
f.	/k'ini/	k'in^{j}i	'meal'
g.	/an-nyəŋ/	an^{j}-n^{j}yəŋ	'hello'
h.	/col-li-/	col^{j}-l^{j}i	'to be sleepy-Cau'
i.	/p'al-li/	p'al^{j}-l^{j}i	'quickly'('be-fast' 'ADVL')
j.	/talli-/	tal^{j}l^{j}i	'to run'
k.	/holli-/	hol^{j}l^{j}i	'to seduce'
l.	/il-lyu/	il^{j}-l^{j}yu	'first class'

Hence, we can generalize that all coronal segments undergo secondary palatalization before a high front vocoid regardless of a morpheme boundary. On the other hand, we can also generalize that underlying /t/ before a high front vocoid undergoes phonemic primary palatalization to [c] only at a morpheme boundary.

Ahn 1985[1] argues in the framework of Lexical Phonology that secondary palatalization has postlexical characteristics (i.e., allophonic, across-the-board and exceptionless) whereas primary /t/-palatalization has lexical characteristics (structure-preserving and derived environment effect). He categorizes secondary palatalization as a postlexical phenomenon and primary palatalization as a lexical phenomenon. Since he misses the fact that /c/ and /t/ undergo secondary palatalization (also in Kim-Renaud 1974), he analyzes primary palatalization as one process but analyzes secondary palatalization as three separate processes, since only coronal /n, s, l/ excluding /t, c/ cannot form a natural class:

[1]Ahn misses the observation that /t/ and /c/ undergo secondary palatalization before a high front vocoid.

(5) Primary /t/-palatalization (a lexical rule)

t --> c / _____{i, y}

(6) Secondary Palatalization (postlexical rules)

/n/-palatalization

n --> n^j / _____{i, y}

/s/-palatalization

{s, s'} --> {s^j, s^j'} / _____{i, y}

/l/-palatalization

l --> l^j / _____{i, y}

However, the three rules of secondary palatalization will be unnecessary if /t, c/ also undergo secondary palatalization. Furthermore, the lexical and postlexical dichotomy in the analysis of Korean palatalization as in Ahn 1985 leads to a rule ordering paradox with Umlaut phenomenon in Korean, as pointed out in Iverson & Wheeler 1988 and Lee 1994. In the Kyungsang dialect, back vowels are optionally fronted before a high front vowel /i/ in the speech of older generations.

(7) (Lack of) application of Umlaut in specific morphological environments (data partly from Lee 1993: 275)

a. Umlaut occurs in a derived environment

i) Nominalizer /i/

/mək-i/ [məki], [meki] 'food' ('eat' 'NOML')

/son-cap-i/ [soncapi], [soncæpi] 'handle' ('hand' 'grip' 'NOML')

ii) Passive/Causative marker

/cap-hi/ [cap^hi], [$cæp^h$i] 'to be caught' ('catch' 'Caus')

/mək-hi/ [$mək^h$i], [mek^hi] 'to be eaten' ('eat' 'Caus')

iii) Nominative /i/ (cf. Y.-K. Han 1980, Y-C. Chung 1968, Y. Lee 1993)

/pəp-i/ [pəpi], [pepi] 'law-Nom'

/cam-i/ [cami], [cæmi] 'sleep=Nom'

iv) Copular /i/ (cf. Y.-K. Han 1980, Y-C. Chung 1968, Y. Lee 1993)

/pəp-i-/ [pəpi], [pepi] 'be a rule'

/səm-i-/ [səmi], [semi] 'be an island'

b. Umlaut occurs in a non-derived environment

/aki/	[aki], [æki]	'baby'
/nampi/	[nampi], [næmpi]	'kettle'
/əmi/	[əmi], [emi]	'mother'
/tali/	[tari], [tæri]	'to iron'

c. Exceptions in Umlaut across a morpheme boundary

i) Adverbial /i/

/kak'ap-i/	[kak'ai], *[kak'æi][2]	'near' (‘be near’ ‘ADVL’)

ii) Gerundive /ki/

/cap-ki/	[capk'i], *[cæpk'i]	'catching' (‘catch’ ‘Ger’)
/nəh-ki/	[nək^{h}i], *[nek^{h}i]	'putting in' (‘put’ ‘Ger’)

iii) Copula /i/

/kam-i/	[kami], *[kæmi]	'to be a parsimon'
/pal-i/	[pari], *[pæri]	'to be a foot'

d. Umlaut has lexical exceptions within a morpheme

/nəpi/	[nəpi], *[nepi]	'width'
/napi/	[napi], *[næpi]	'butterfly'
/cəki/	[cəki], *[ceki]	'there/that place'

Umlaut applies in both derived and non-derived environments as in (7a & b). Only the causative/passive marker and a nominalizer suffix trigger Umlaut whereas other suffixes or clitics don't.

However, we observe that secondary palatalization blocks Umlaut (for different views but with the same effect, Iverson & Wheeler 1988, Hume 1990, Y. -S. Kang 1991, Lee 1993[3]):

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[2] /p/ is deleted before a vowel.

[3] In Iverson & Wheeler 1988, Hume 1990, Y. S. Kang 1991 and Lee 1993, they miss the fact that [c], whether derived or nonderived, undergoes allophonic secondary palatalization. Hence, the argument for palatal blocking of Umlaut goes two ways: Secondary palatalization of /s/, /l/ and /n/ and primary /t/-palatalization block Umlaut. In this paper, however, we will show that allophonic secondary palatalization, which is assumed to be spreading of the V-pl/Cor from a following /i/, is blocking Umlaut, which is assumed to be spreading of the same feature from the same source vowel to another vowel.

(8) Umlaut blocked across a secondarily palatalized consonant[4]

a.	/mat-i/	mac^{j}-i, *mæc^{j}-i	'the eldest' (‘first’ ‘NOML’)
b.	/mul-pat-i/	mul-pac^{j}-i, *mul-pæc^{j}-i	‘water holder’ (‘water’ ‘receive’ ‘NOML”)
c.	/kət-hi-/	kəc^{jh}i, *kæc^{jh}i	‘be removed’ (‘remove’ ‘Caus’)
d.	/ənni/	ən^{j}n^{j}i, *en^{j}n^{j}i	'sister'
e.	/alli-/	al^{j}l^{j}i, *æl^{j}l^{j}i	'to inform'
f.	/kəci/	kəc^{j}i, *kec^{j}i	'beggar'
g.	/tac^{h}i-/	tac^{jh}i, *tæc^{jh}i	'get hurt'
h.	/əti/	ət^{j}i, *et^{j}i	'where'
i	/kasi/	kas^{j}i, *kæs^{j}i	'thorn'

The assumption that secondary palatalization is postlexical and Umlaut is lexical in the framework of LP leads to a rule ordering paradox:

(9) Two potential rule orderings

a. If Umlaut is ordered before Secondary Palatalization

UR	/kasi/
1. (lexical) Umlaut	kæsi
2. (postlexical) Secondary Palatalization	kæs^{j}i
Output	*[kæs^{j}i]

b. If Secondary Palatalization is ordered before Umlaut

UR	/kasi/
1. (lexical) Secondary Palatalization	kas^{j}i
2. (lexical) Umlaut	------
Output	[kas^{j}i]

[4]A reviewer points out the following counter-example in Standard Korean:

/cəc-hi-/ cəc^{jh}i, cec^{jh}i ‘bend back’ (‘bend’ ‘Caus’)

Umlaut in Standard Korean is a pending question for further study since it is rare and irregular. In the Kyungsang Dialect, however, [cec^{jh}i] is the only possible output and hence the input must be /cec-hi-/ since no alterantion is allowed. In other words, [e] is not the result of Umlaut in this case.

The demonstrated ordering paradox suggests that rule-based approaches with two levels in the framework of LP are problematic.

Kiparsky 1993 correctly observes that all (phonologically derived and non-derived) coronals undergo allophonic secondary palatalization. However, Kiparsky analyzes primary and secondary palatalization as a single process which can apply lexically and postlexically in the framework of Lexical Phonology. He tries to explain why primary /t/-palatalization takes place only in a derived environment by proposing that the Non-Derived Environment Blocking effect in some phonological processes is the result of structure-building rules which apply to an underspecified representation. According to Kiparsky, structure-building rules can apply to only underspecified representations. As a result, if a feature [F] is underlyingly prespecified, structure-building rules cannot override the prespecified [F]. Hence, NDEB effect is achieved.

Kiparsky's new approach to NDEB handles Korean palatalization as follows. As secondarily palatalized segments are not phonemic and arise only before a high front vocoid, secondary palatalization is automatic and obligatory. The following output sequences are not allowed on the surface:

(10) a. *[...s^{j}a...], *[...n^{j}u...], *[...t^{j}o...], *[...c^{j}a...] . . . etc.
b. *[...si...], *[...ni...], *[...ti...], *[...ci...]

Under the assumption that underlying /t, t^{h}/ are distinguished from /c, c^{h}/ by [±anterior], Kiparsky proposes that coronal segments are minimally specified as follows in terms of the feature [anterior].

(11)

	/t, t^{h}/	/c, c^{h}/	/s, n, l/
Before i	[+ant]	[0ant]	[0ant]
Elsewhere	[0ant]	[-ant]	[0ant]

According to Kiparsky, the underlying /t/ before a high front vocoid within the same morpheme is prespecified for [+anterior] but an underlying /c/ in the same position is underspecified for [-anterior], under the assumption that the following phonetic specifications of the (non-)palatalized coronals are used in Korean:

(12) from Kiparsky 1993

	t	t^j	c	c^j	s	s^j
High	-	+	-	+	-	+
Anterior	+	-	-	-	+	-
Delayed Release	-	-	+	+	-	-

Note that Kiparsky crucially assumes that palatal /c/ is an affricate. Kiparsky assumes that both primary and secondary palatalization are uniformly represented as the spread of [-anterior] and [+high] to coronal consonants from a following [+high] front vocoid, following the proposal of Clements 1989 and Lahiri and Evers 1989 that front vowels are represented with [+coronal]. Kiparsky actually assumes that palatalization is the spreading of the Place node with dependents [-anterior] and [+high], not the independent spreading of each feature [-anterior] or [+high]. The core of his proposal is as follows, though he did not spell out details:

(13) a. In the lexical component, palatalization applies to all coronals. Secondary Palatalization is also allowed to apply lexically in spite of lack of secondarily palatalized segments in the lexical inventory due to linking constraint (Hayes 1986, Itô 1986) under the assumption that multiply linked structures as a result of spreading are allowed in the lexical component.

b. In the postlexical component, palatalization applies in feature-changing fashion.

According to Kiparsky, the different realization of lexical and postlexical palatalization is due to a word-level rule at the end of the lexical component, which specifies [-anterior, +high] obstruent stops (i.e., secondarily palatalized [t^j] before a high front vocoid at a morpheme boundary in the lexical component) as [+delayed release] (refer to the difference between /mati/ and /mat-i/ below). According to Kiparsky, this word-level delayed released rule crucially enables /mat-i/ to be realized as [mac^{j}i] at the end of the lexical component. Kiparsky's analysis provides the following derivations for primary and secondary palatalization:

(14) Derivations according to Kiparsky 1993

Input	rules	/mati/ | [+ant]	/mat-i/ | [0ant]
Lexical Component	Pal.		t i [+hi] [-ant]
Word-level	[-ant, +high] --> [+delayed release]		mac^{j}i
Postlexical Component	Pal. (feature-changing)	t i ≠ [+ant] [+hi] [-ant]	
Output		[mat^{j}i]	[mac^{j}i]

Input	rules	/paci/ | [0ant]	/nac-i/ | [-ant]
Lexical Component	Pal.	c i [+hi] [-ant]	c i [+hi] [-ant]
Word-level	[-ant, +high] --> [+delayed release]	pac^{j}i	nac^{j}i
Postlexical Component	Pal. (feature-changing)		
Output		[pac^{j}i]	[nac^{j}i]

Kiparsky's analysis of Korean (primary and secondary) palatalization treats palatalization as a single process which spans both lexical and postlexical components. Furthermore, it crucially relies on underlying

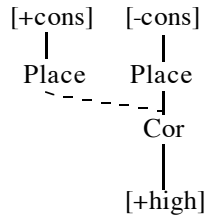
specification of [+ant] for /t, t^h/ before a tautomorphemic high front vocoid and underspecification of [-ant] for underlying /c, c^h/ before a tautomorphemic high front vocoid. Furthermore, Kiparsky crucially depends on the word-level delayed released rule which affects only the obstruent which inherits [-ant, +high] features via lexical palatalization. However, the problem of this approach is that it cannot explain why Umlaut is blocked in /mati/ [mat^{j}i]. We have shown that Umlaut must precede Palatalization. According to Kiparsky, postlexical application of Palatalization is assumed to derive [mat^{j}i] from /mati/. Then there is no way to explain why Umlaut is blocked, as in *[mæt^{j}i] in the Kyungsang Dialect, since palatalization must precede Umlaut.

2. Iverson 1993

On the other hand, Iverson 1993 tries to analyze the two types of palatalization as one uniform process within one level via appealing to Kiparsky's 1973 revised alternation condition, which restricts application of neutralization rules only to derived environments. As mentioned previously, Iverson misses the fact that not only /s/, /n/ and /l/ but also /t/ and /c/ undergo secondary palatalization. On the other hand, according to him, /t/ undergoes primary palatalization only in a derived environment but /t/ and /c/ are realized as [t] and [c] (i.e., no primary or secondary palatalization), respectively, before a tautomorphemic high front vowel (i.e., in a non-derived environment).

Iverson also proposes that primary and secondary palatalization are a uniform process. His rule of Palatalization is characterized as spreading of the tongue body features of a high front vocoid to a preceding underspecified consonant in the lexical component.

(15) Palatalization (lexical)



On the other hand, Iverson provides the following default configuration for those (coronal) consonants without inherent place of articulation:

(16) Default coronal consonants

Iverson proposes the following context-free underspecification for coronals:

(17) Context-free underspecification

/t, t^h, t'/	unspecified for [high]
/č, c^h, č'/	[+high]
/s, s'/	unspecified for [high]

Iverson suggests that if we adopt the reversed implication of revised alternation condition as a constraint, we can explain why phonemic primary palatalization is restricted to a derived environment whereas allophonic secondary palatalization is blind to a derived environment.

(18) a. If a rule is lexical (observes the derived environment constraint), then it is also structure-preserving (neutralizing). (Kiparsky's 1973 revised alternation condition in Iverson's interpretation)

b. If a rule application is neutralizing (structure-preserving), then it also observes the derived environment constraint. (Iverson's 1993 reversed implication of revised alternation condition)

Hence, Iverson assumes that the derived environment constraint restricts only structure-changing applications of a lexical rule. And he also assumes that Korean palatalization is a lexical rule, based on the aforementioned observation that Umlaut is blocked across a palatal or a palatalized coronal (Hume 1990, Iverson & Wheeler 1988) (see the data in (8), the rule ordering paradox in (9)). The phonological change from the underspecified /t, t^h, t'/ (= /T, T^h, T'/) to /č, $č^h$, č'/ is the result of neutralizing (structure-preserving)

application of the palatalization rule (15), and the neutralizing application of palatalization has to be confined to a derived representation according to the Derived Environment Constraint (18b). And the neutralizing application of palatalization in /mat-i/ to [maci] 'the first son' must involve a morpheme boundary (to avoid violation of the Derived Environment Constraint). Hence, the derived environment constraint in (18b) is respected in this case since a morpheme boundary is involved. On the other hand, the neutralizing application of palatalization in /mati/ -> *[maci] (the correct output is [mat^{j}i]) does not respect the Derived Environment Constraint since a morpheme boundary is not involved (violation of the Derived Environment Constraint). However, the structure-changing application of lexical palatalization need not involve a morpheme boundary since the structure-changing application of the lexical palatalization is not restricted to a derived environment. Hence, structure-changing application of the lexical palatalization can occur in /si/ -> [s^{j}i] 'poem' and /mas-i/ -> [mas^{j}i] 'taste-Nom' and it does not violate the Derived Environment Constraint, regardless of whether a derived environment is involved or not.

The problem in the analysis of Iverson 1993 is that he cannot explain why /t, t^{h}, t'/ undergo primary and secondary palatalization to [c^{j}, c^{hj}, c^{j}'] before a high front vocoid, as observed in this paper. This is because Iverson does not distinguish between primary /t/-palatalization and secondary /t/-palatalization. Furthermore, Iverson cannot explain why /t, t^{h}, t'/ undergo secondary palatalization to [t^{j}, t^{jh}, t^{j}'] before a tautomorphemic high front vocoid, as observed in this paper. Note that /mati/ is realized as [mat^{j}i] in which /t/ is secondarily palatalized but not primarily palatalized. According to Kiparsky's account, on the other hand, the /t/ before a tautomorphemic /i/ is prespecified for [+ant] and lexical application of palatalization is blocked due to the prespecified [+ant]. Only postlexical application of palatalization applies to change /t/ to [t^{j}] (refer to the similar derivation of /mati/ in (14). Hence, Kiparsky provides a correct prediction in this case.

We will show that primary and secondary palatalization are independent of each other and one level is enough to analyze primary and secondary palatalization. Furthermore, we will also argue that underlying specification of [+ant] for /t, t^{h}/ before a tautomorphemic high front vocoid alone is enough to analyze primary palatalization.

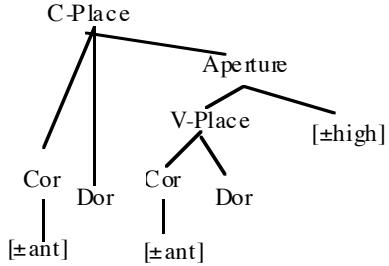
3. Assumed Hierarchical Feature Representations

First of all, we assume that palatal /c/ is represented as having a Coronal node with a [-anterior] dependent (Hume 1992, Clements 1991, Chomsky & Halle 1968). On the other hand, we assume that /t/ has only the Coronal node. Other coronal segments are minimally represented for place like /t/.

(19)

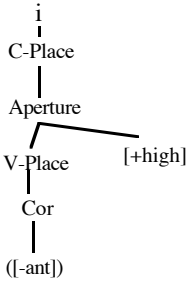
We assume the following feature geometry, adopted from Clements & Hume 1995 and Hume 1992:

(20) Feature Geometry



We further argue that a high front vocoid has the following hierarchical structure.

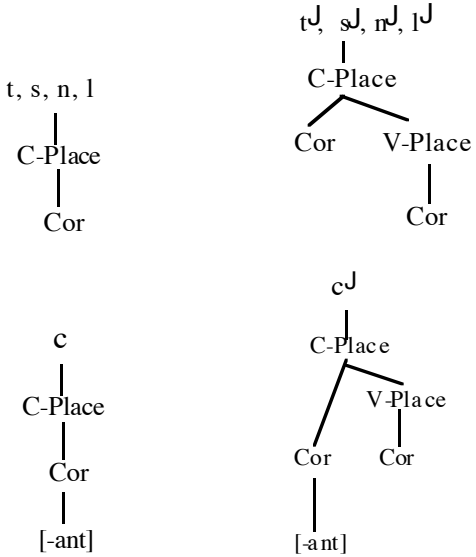
(21) Front high vocoid



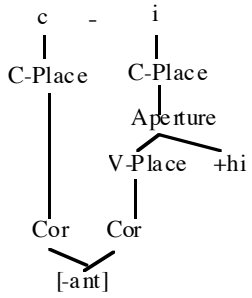
([-anterior] is a redundant feature which need not be underlyingly present, see discussion below).

Hence, unlike those specifications assumed for primary and secondary palatalization in Kiparsky 1993 (see (12)), we will have the following representations of the non-palatalized, primarily palatalized and secondarily palatalized coronals in Korean:

(22) Hierarchical feature specifications of coronal consonants



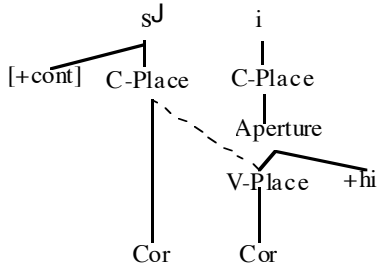
As for the redundant feature [-ant] in a high front vocoid, we propose that [-ant] is a redundant feature in a high front vowel which surfaces only when the high front vocoid is able to obtain [-ant] by sharing it with a consonantal neighbor. We will show in the next section that the behavior of [-ant] in Korean is similar to [voice] in a nasal consonant in Yamato Japanese in Itô, Mester & Padgett 1993b (hereafter IMP). We propose that [-ant] is shared by a coronal consonant and a following high front vocoid in primary palatalization, ignoring secondary palatalization for the moment:



(/t/ -> [c])

For comparison, we will propose in section 5 that secondary palatalization is represented as sharing of a V-Place node of a high front vowel with a preceding coronal consonant (see discussion in section 5):

(24) Secondary Palatalization



(/s/ -> [s^j])

Note that in secondary palatalization, the V-Place node of a high front vocoid is shared by the preceding coronal consonant. This is the topic which will be discussed in detail in section 5.

4. Analysis of Primary Palatalization

Itô, Mester & Padgett 1993b implement the two notions licensing and redundancy in OT to explain voicing assimilation in a sequence of a nasal C and a voiceless obstruent in Yamato Japanese:

(25) Observation: a nasal must share [voice] with a following consonant (IMP 1993b)

a.	/yom-te/	yon-de	'reading'
b.	/šin-te/	šin-de	'dying'
c.	tombo	'dragonfly'	*tompo
d.	šindo-i	'tired'	*šinto-i

From the observation that a nasal must share [voice] with a following consonant, IMP propose the following LICENSE[voice] and NasVoi constraints which appeal to the two notions licensing and redundancy, respectively:

(26) a. LICENSE[voice]: [voice] is licensed when linked to an obstruent

b. NasVoi: [nasal] ⊃ [voice]
[nasal] implies [voice] redundantly.

c. Constraint ranking: LICENSE[voice] >> NasVoi

d. Tableau

	LICENSE[voi]	NasVoi
☞ k a m i		*
k a m i | V	*!	
t o m p o		*!
t o m p o | V	*!	
☞ t o m b o \/ V		

In the first tableau above, the second candidate violates high ranked LICENSE[voi]. On the other hand, the first candidate violates low ranked NasVoi. As a result, the first candidate is optimal. In the second tableau, the last candidate does not violate any constraint and is optimal.

We are going to show that the redundant feature [-ant] of a high front vowel in Korean patterns exactly together with [voice] in Yamato Japanese in terms of feature licensing and redundancy[5]. We argue that [-ant] is a redundant feature of a high front vowel and we provide the following constraint:

(27) FRONT-HI[-ant]: [V-pl/Cor, +high] ⊃ [-ant]
A front high vowel implies [-ant] redundantly.

We further argue that the consonantal feature [-anterior] must be licensed by the feature [-son][6].

(28) LICENSE[-anterior]
[-anterior] is licensed by [-son].

(29) Constraint ranking
LICENSE[-anterior] >> FrontHi[-ant]

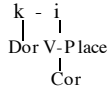
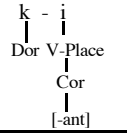
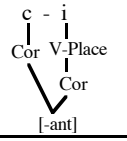
The licensing constraint LICENSE[-anterior] is probable since [-anterior] is a typical coronal consonantal place feature. Furthermore, only /t/ undergoes primary palatalization (i.e., sharing [-ant] by an obstruent coronal and a following high front vocoid) excluding sonorant coronal /l, n/. The reason why /s/ does not undergo primary palatalization will be spelled out later. As a result, any [-anterior] which is associated with a high front vocoid must be licensed by being additionally linked to an obstruent. On the other hand, [-anterior] is not allowed to appear under a high front vocoid which is preceded by a non-coronal consonant. This is because the feature [dor] or [lab] in a non-coronal consonant is not compatible with [-ant] (*[dor, -ant] or *[lab, -ant]). Hence, delinking of [dor] or [lab] from the non-coronal consonant is necessary if sharing of [-ant] between the non-coronal consonant and a following high front vocoid occurs. Then delinking of [dor] violates IDENT-IO[dor]. When we assume that IDENT-IO[dor] (and LICENSE[-ant]) is ranked above FRON-HI[-ant], we can explain why [-ant] cannot be shared by a dorsal consonant and a following high front vocoid: i.e. lack of primary palatalization in /ki/. The following is a tableau to illustrate this idea:

---

[5] This observation is due to Rolf Noyer (p.c.).

[6] Recall that secondary palatalized [nʲ] and [lʲ] are represented with V-pl/Cor.

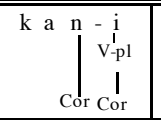
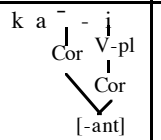
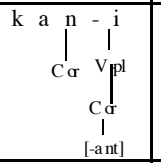
(30) /ki/ ki ‘flag’

/ki/	IDENT-IO [dor]	LICENSE [-ant]	FRON-HI [-ant]
☞ 			*
		*!	
	*!		

The tableau above shows that the optimal candidate (the first candidate) does not have [-ant] under the V-place of the high front vocoid. Other candidates violate either LICENSE[-ant] or FrontHi[-ant] and are eliminated.

When a high front vowel is preceded by a coronal nasal consonant, the optimal candidate shows that [-ant] does not appear on the surface at all:

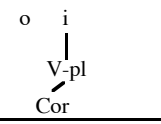
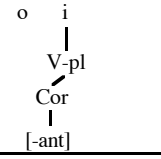
(31) /kan-i/ kan^{j}-i 'saltiness-Nom'
(secondary palatalization is ignored.)

/kan-i/	LICENSE [-ant]	FRON-HI [-ant]
☞ 		*
	*!	
	*!	

In the tableau above, the second and third candidates violate higher ranked LICENSE[-ant] since [-ant] is not licensed. On the other hand, the first candidate violates lower ranked FRONT-HI[-ant]. Hence, the first candidate is optimal.

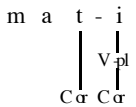
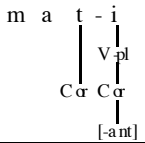
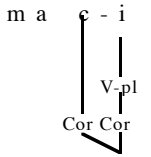
The redundant feature [-ant] will not appear under a high front vocoid which is preceded by a vowel, since it will not be licensed..

(32) /oi/ oi 'cucumber'

/oi/	LICENSE [-ant]	FRON-HI [-ant]
☞ 		*
	*!	

The following tableau illustrates how the two constraints interact with each other in primary palatalization (note that we assume tentatively that primary palatalization always involves a morpheme boundary and we ignore secondary palatalization in the following tableau):

(33) /mat-i/ mac^{j}-i 'first son'

/mat-i/	LICENSE [-ant]	FRON-HI [-ant]
a 		*!
b 	*!	
c ☞ 		

Candidate (a) violates FRON-HI[-ant] since [i] does not carry [-ant] under the V-pl node. Candidate (b) violates LICENSE[-ant] since [-ant] is not licensed. However, candidate (c) does not violate any constraint and is therefore optimal.

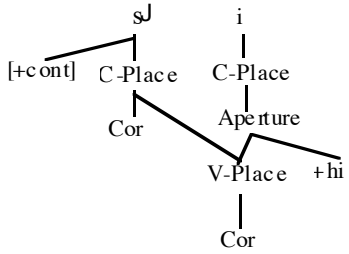
Based on the discussion so far, we propose the following constraint ranking:

(34) Constraint ranking for primary palatalization
LICENSE[-ant] >> FrontHi[-ant]

5. Analysis of Secondary Palatalization

As for secondary palatalization, in which a coronal consonant secondarily palatalizes before a high front vocoid, we propose the following representation in which the V-Place of a high front vowel is shared by a preceding coronal consonant:

(35) Feature sharing in secondary palatalization[7]



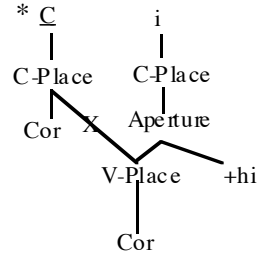
(t -> t^j, s -> s^j, c -> c^j, n -> n^j, l -> l^j)

The spreading of the V-Place of a high front vocoid to a neighboring consonant is limited to a coronal consonant due to its close relation with coronality (Zubritskaya 1995 for Russian, Selkirk 1991).

To explain the spreading of the V-Place of a high front vocoid to a preceding coronal consonant in secondary palatalization, we propose the following constraint for secondary palatalization of a coronal consonant before a high front vocoid (Rolf Noyer, personal communication):

[7]Primary palatalization is represented by sharing [-ant] by /t/ and a following front high vocoid whereas secondary palatalization, by sharing the V-pl/Cor by a coronal and a following front high vocoid. It may seem strange to see that sharing more structure entails a smaller change. Actually this problem stems from the feature hierarchy in Clements & Hume 1995, which is assumed in this paper. It is also possible to assume that [-back] replaces V-place/Cor in the feature hierarchy, since we will show that secondary palatalization and Umlaut involve spreading of V-place/Cor.

(36) PAL:



Ill-formed (*) unless a coronal consonant and a following high front vowel share a V-Place.

Since secondary palatalization is obligatory in Korean, PAL is ranked highly in the constraint ranking.

Korean has allophonic flapped coronal [r], which is not subject to secondary palatalization. Bhat 1974: 66 also reports that /r/ resists palatalization cross-linguistically. Mester & Itô 1989 and Zoll 1996 also note that /r/ resists palatalization in Japanese mimetics. As for non-existence of secondarily palatalized version of the flapped [r], it is probable from the articulatory point of view that flapped [r] preferentially resists palatalization[8], as noted by Kim-Renaud 1974/1991: 201-202:

> "It seems natural that the flap r should escape palatalization, because the most agile front is employed in making the quick flipping contact and it would require more effort for the tongue tip to make the contact with the palatal region rather than with the alveo-dental region or for the blade of the tongue to make that flipping contact with the roof of the mouth."

Now we have to handle the idiosyncratic nature of /t/ before a tautomorphemic high front vowel which does not undergo primary palatalization. Recall that only /t/ before a high front vocoid across suffixal and clitic boundaries undergoes primary palatalization. We observe that the frequency of the /ti/ sequence within a morpheme is quite limited and morpheme-internal /ty/ does not exist at all.

---

[8] Rolf Noyer (personal communication) notes that Irish has secondarily palatalized [r^{j}], though Irish [r^{j}] is not realized as flapped but as slightly fricative.

We propose that morpheme-internal /t/ which appears before a high front vocoid is underlyingly specified for [+anterior], based on the observations that only underlying /t/ before a tautomorphemic font high vocoid does not undergo primary palatalization. The underlying specification of [+anterior] idea was first introduced in Kiparsky 1993 for Korean primary palatalization and secondary palatalization, though it was utilized in a different analysis of the same Korean primary palatalization (and also secondary palatalization). We propose an OT analysis with the spirit that prespecified [+ant] of /t/ before a tautomorphemic high front vocoid will block spreading of [-ant] from a following high front vocoid. There is a piece of diachronic evidence for the [+ant] prespecification in /t/ before a high front vocoid. Evidence comes from diachronic data of primary palatalization. According to K.-M. Lee 1961/1972 and Kim-Renaud 1974/1991, morpheme-internal /t/-palatalization took place around the late 17th and 18th centuries.

(37) Diachronic phonemic /t/-palatalization (Data from K.-M. Lee 1971 and K.-W. Nam 1992)
(allophonic secondary palatalization ignored)

a.	tikhi-ta	>	cikhi-ta	(> cik^{h}i-ta)	'to keep'
b.	ti-sik	>	ci-sik		'knowledge'
c.	kuti	>	kuci		'insistently'
d.	pat-ti	>	pat-ci		'to receive-Neg'
e.	tyuŋ-ha-ta	>	cuŋ-ha-ta		'to be important'
f.	taŋt^{h}i	>	taŋc^{h}i		'unreasonable'
g.	o-ti	>	o-ci		'to come-Neg'

The current regional variation of the result of diachronic primary palatalization is summarized as follows (K.-M. Lee 1972):

(38) a. In south-eastern Korean, /t, t^{h}, t'/ and /k, k^{h}, k'/ palatalize to phonemic [c, c^{h}, c'] before a high front vocoid and /y/ deletes.
b. In standard Korean, only /t, t^{h}, t'/ palatalize to phonemic [c, c^{h}, c'] before a high front vocoid and /y/ deletes.
c. In north-eastern Korean, palatalization does not take place at all and /ti/ sequence is still retained on the surface nowadays.

As the result of diachronic primary palatalization, morpheme-internal /ti/ and /ty/ sequence would not be expected to occur in Standard Korean. However,

as shown previously, some morpheme-internal /ti/ sequences survived the diachronic primary palatalization. According to the historical data, these morphemes had a back unrounded vowel between /t/ and /i/ before the 19th century. /ɨ/-deletion in that position took place around the 19th century: /ɨ/ was deleted before /y/ which in turn became /i/. This phonological change revived the appearance of /ti/ sequence within a morpheme by the time the phonological change of ti -> ci is restricted to the derived environment only.

(39) Diachronic /ɨ/-deletion around the 19th C (Data from K.-M. Lee 1972)
(secondary palatalization is ignored)

a.	kyəntɨy-ta	> kyənti-ta		'to endure'
b.	mutɨy-ta	> muti-ta		'to be dull'
c.	stɨy	> sti	> t'i	'belt'

From the synchronic point of view, primary palatalization can be viewed as lexical diffusion. Kiparsky 1988, 1995 provides English ū-shortening as a typical case of lexical diffusion. English ū-shortening tends to extend its phonological context from the core environment (40a) to the peripheral environments (40b) and (40c) in an idiosyncratic manner by relaxing its context on the left and on the right (Dickerson 1975).

(40) From Kiparsky 1995: 643-644

a. [-anterior] ____ [-anterior, -coronal]
cook, hook, shook, rook, brook, crook, hookah (short)

b. ____ [-anterior, -coronal]
took, book, nook, look, forsook, Wookie (short)
snook, snooker, stook, boogie, Sook, gadzooks, spook (variable)
bazooka (long)

c. [-anterior] ____
good, could, should, hood "covering", hoodwink (short)
roof, rooster, hoodlum, hoof, room, Root, hoodlum, hood "ruffian", coop, proof (variable)
brood, shoot, hoot, behoove, scoop, coon, coot, roost, groove … (long)

Kiparsky 1995 explains this case by appealing to underspecification. The core regularity can be explained by assuming a rule which assigns a single

mora to stressed /u/ between certain consonants and two moras elsewhere. The original rule which is assumed to apply in the context [-anterior] ____ [-anterior, -coronal] extends in the contexts in (40b) and (40c) by simplifying the rule's environment. The extended rule simply applies to the words which always have short [ŭ] in the context which is reanalyzed as unmarked. On the other hand, lack of application of the rule in (40b) and (40c) is explained by lexical prespecification of two moras in words with long [ū] in those contexts. The explanation for this lexical diffusion case is based on the observation that there is a systematic context (the core shortening environment) where length is systematically predictable.

Now, let us turn back to Korean primary palatalization. As was shown previously, primary palatalization takes place systematically before a high front vowel. By prespecifying [+anterior] for /t/ before a tautomorphemic high front vocoid, we will have the following [anterior] specification for /t/:

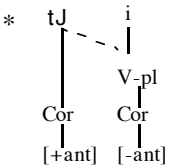
(41)		in morpheme-internal /ti/	elsewhere
	/t/	[+anterior]	Ø

Since /t/ which is prespecified for [+ant] is not allowed to additionally link to [-ant] without deleting the existing [+ant], if IDENT-IO[+ant] is highly ranked, we can explain why primary palatalization cannot take place in the prespecified /t/ for [+ant] before a tautomorphemic /i/.

Since [+ant] is not compatible with [-ant] within a segment, we propose the following phono-constraint (42) to block the case in (43):

(42) *[+ant, -ant]

(43)



In (43), /t/ is prespecified for [+ant] before tautomorphemic /i/ and the redundant [-ant] surfaces under the V-place shared by a coronal obstruent and a high front vocoid. We will assume that *[+ant, -ant] is a property of GEN rather than an actual (violable) constraint due to the inviolable nature of

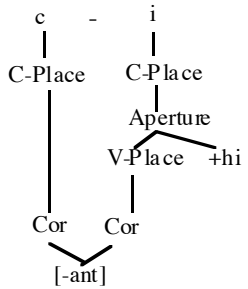
*[+ant, -ant]. No language has a segment which has both [+ant] and [-ant] at the same time.

Let us turn to the data in which primary or secondary palatalization occurs:

(44) a. /mati/ mat^{j}i 'knot' (Root)
b. /mat-i/ mac^{j}-i 'the first son' (Root-ADVL)

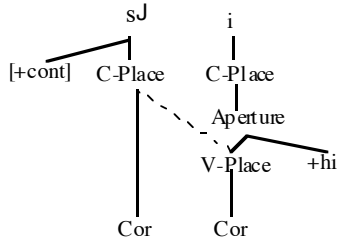
We proposed in section 3, 4 and 5 that primary palatalization and secondary palatalization are represented as follows:

(45) Primary Palatalization (repeated from (23) in section 3))



(/t/ -> [c])

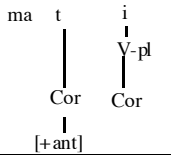
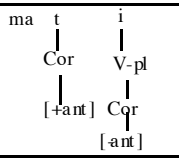
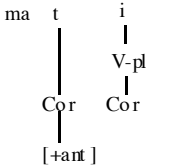
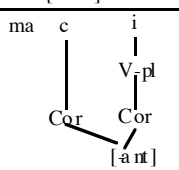
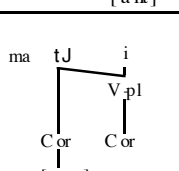
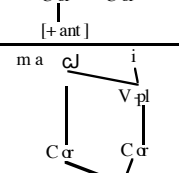
(46) Secondary Palatalization (repeated from (24) in section 3))



(/s/ -> [s^{j}])

We further proposed that /t/ before a tautomorphemic high front vocoid is underlyingly specified for [+ant], as we treated the example in (44a) as a case of lexical diffusion. The following tableau illustrates why /t/ which is prespecified for [+ant] before a tautomorphemic /i/, does not undergo primary palatalization though it undergoes secondary palatalization:

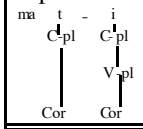
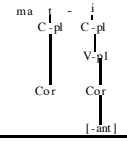
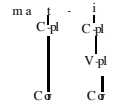
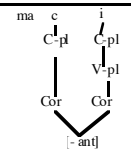
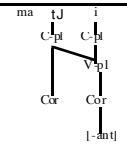
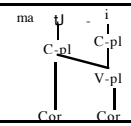
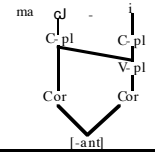
(47) /mati/ mat^{j}i 'knot'

input	LICEN [-ant]	IDENT-IO [+ant]	PAL	FRON-HI [-ant]
				
	*!		*	
			*!	*
		*!	*	
☞ 				*
		*!		

The tableau above shows how the underlyingly specified [+ant] in /t/ blocks the double linking of [-ant] to the prespecified /t/ for [+ant] and a following /i/. Hence, the /t/ which is prespecified for [+ant] does not undergo primary palatalization.

Now we are going to show why /t/ undergoes primary and secondary palatalization to [c^{j}] before a high front vocoid at suffixal and clitic morpheme boundaries. Recall that /t/ before a tautomorphemic high front vocoid is prespecified for [+ant] but /t/ elsewhere is unspecified for [+ant].

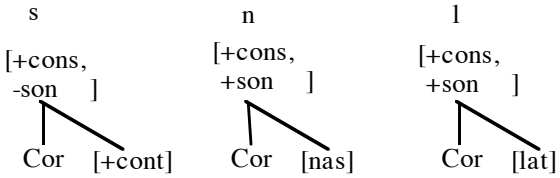
(48) /mat-i/ mac^{j}-i 'the oldest son' (‘first’ ‘NOML’)

input 	LICEN [-ant]	PAL	FRON-HI [-ant]
	*!	*	
		*!	*
		*!	
	*!		
			*!
☞ 			

In the tableau above, only the last candidate, in which primary and secondary palatalization take place, does not violate any constraint and is therefore optimal.

/n/, /s/ and /l/ undergo only secondary palatalization. We assume the following hierarchical feature representations for coronal segments in Korean:

(49) Hierarchical feature representations for /n/, /s/ and /l/



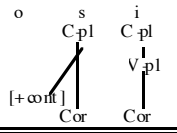
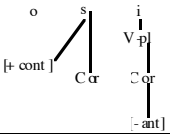
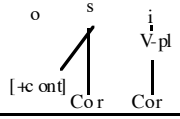
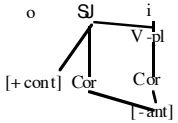
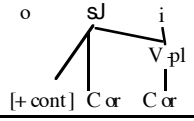
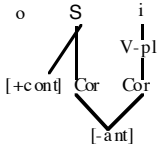
We propose the following constraint which says that continuants /s, s'/ are not compatible with [-ant] given the assumed hierarchical feature specification in (22).

(50) *[+continuant, -anterior]

This phono-constraint, which is assumed to be highly ranked, can explain why /s/ does not undergo primary palatalization to [ʃ]. Recall that we already proposed that the reason why /n/ and /l/ do not undergo primary palatalization (i.e., sharing [-ant] by a coronal obstruent and a following high front vocoid) is that [+son] in /n/ and /l/ cannot license [-ant] in Korean. We proposed that [-ant] is licensed by [-son] (i.e., LICENSE[-ant]).

The following tableau illustrates how input /s/ before /i/ is realized as secondarily palatalized [s^j]:

(51) /os-i/ os^{j}-i ‘clothes-Nom’

input	LICEN [-ant]	*[+cont, -ant]	PAL	FRON-HI [-ant]
				
a 	*!		*	
b 			*!	*
c 		*!		
d ☞ 				*
e 		*!	*	

Candidate (d) violates only lower ranked FRONT-HI[-ant] since /i/ does not surface with [-ant]. Since other candidates violate at least one higher ranked constraint, candidate (d) is optimal.

The following tableau illustrates how the fake geminate /l/ is realized as a secondarily palatalized [l^{j}l^{j}]:

(52) /mal-li-/ mal^{j}-l^{j}i- 'stop-Caus'

input	LICENSE [-ant]	PAL	FRON-HI [-ant]
a	*!	*	
b		*!	*
c	*!	*	
d ☞			*
e	*!		

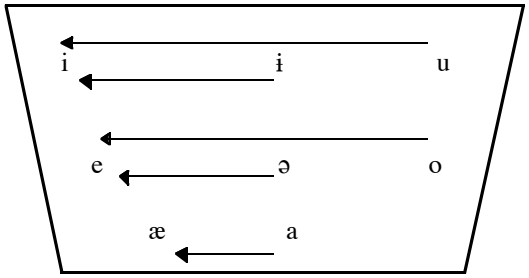
So far we have proposed the following constraint ranking for primary palatalization and secondary palatalization in Korean:

(53) Proposed constraint ranking
LICENSE[-ant], PAL, *[+cont, -ant] >> FRON-HI[-ant]

6. Umlaut in the Kyungsang Dialect

As shown previously in the data on Korean Umlaut in the Kyungsang dialect in section 1, Umlaut is a phonological phenomenon in which a back vowel optionally becomes a front vowel of the same height when followed by a high front vocoid. The following diagram shows the phonological changes of back vowels in Korean Umlaut:

(54) Vowel transitions in Korean Umlaut



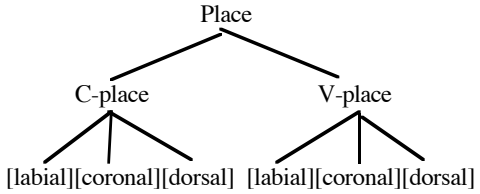
Hume 1990 observes that Umlaut does not take place across a palatal consonant /c/, including a derived palatal /c/, or across secondarily palatalized [n^j, s^j, l^j]. Other intervening consonants are argued to be transparent to Umlaut. Under the assumption that primary and secondary palatalization can be unified as a single process and can be uniformly represented by spreading of [+coronal] from a high front vocoid to a preceding coronal consonant, she provides the following generalization as to Umlaut blocking:

(55) Hume's generalization as to Umlaut blocking
Observation 1: Umlaut is blocked across derived or non-derived palatal consonant c̲.
Observation 2: Umlaut is blocked across secondarily palatalized [n^j, s^j, l^j].
Generalization: Umlaut is blocked across a palatal consonant.

Hume's generalization as to palatal blocking of Umlaut is based on two incorrect observations that the phonological change of /t/ to a palatal before /i/ at a suffixal or clitic boundary (i.e., primary palatalization) does not involve secondary palatalization, and that /t/ does not undergo secondary palatalization before a tautomorphemic high front vocoid (Kim-Renaud 1974, Iverson 1987, Iverson 1993 and references therein), unlike the observations provided in this paper (also in Kiparsky 1993 and K.-M. Lee 1972).

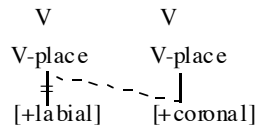
Before we consider the analysis of Umlaut in the framework of OT, we will summarize Hume's 1990 analysis of Umlaut and its palatal blocking. Hume assumes the following feature geometry, adopted from Clements 1989a:

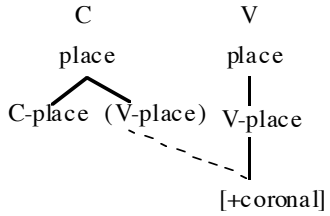
(56) Feature Geometry (Clements 1989a)



Hume assumes without detailed discussion that primary and secondary palatalization need not be distinguished and can be unified as a single process: spreading of [+coronal] of a high front vocoid to the V-place node of a preceding consonant. She further argues that Umlaut is represented by spreading of [+coronal] of a high front vocoid to a preceding back vowel.

(57) a. Umlaut b. Palatalization

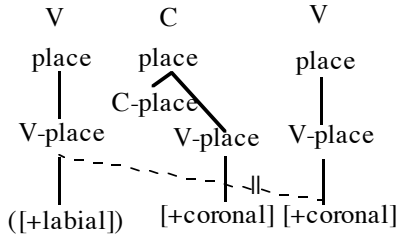




Structure preservation, which prevents cooccurrence of [+labial, +coronal], plays a crucial role in her analysis of Umlaut. In her feature geometry, palatal consonants and front vowels are specified for [+coronal] as a dependent

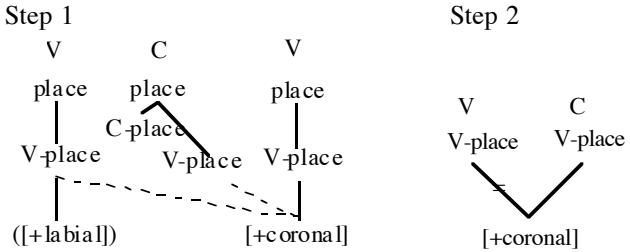
of V-place node. In this way, she derives the opacity of underived /c/ in Umlaut by appeal to the Line-Crossing prohibition:

(58) Blocking of Umlaut across an underived palatal /c/



The Umlaut blocking effect across intervening derived palatalized consonants is explained by two separate steps. Namely, [+coronal] spreads to a preceding vowel across a derived palatalized coronal consonant. But according to Hume, a later Dissimilation rule delinks [+coronal] from the V-place of a preceding vowel. This Dissimilation rule is purely ad hoc.

(59) Blocking of Umlaut across derived palatalized coronal consonants



Hume's analysis of Umlaut is crucially based on the assumption that primary and secondary palatalization can be unified as a single process and as a result, it does not distinguish between primary and secondary palatalization. This assumption results in a wrong generalization that any intervening palatal or palatalized consonant blocks Umlaut. However, we have already shown that Umlaut is blocked only by a secondarily palatalized consonant, and primary and secondary palatalization are independent from each other. In previous sections, we provided the following motivation to treat primary palatalization and secondary palatalization as separate phonological phenomena:

(60) Phonological differences between primary and secondary palatalization
   a. Only /t/ is subject to primary palatalization whereas all coronal consonants including /t/ are subject to secondary palatalization
   b. Primary palatalization has lexical idiosyncratic exceptions (a lexical diffusion case) whereas secondary palatalization does not.

Unlike Hume's generalization that Umlaut is blocked by a palatal consonant, we observe that Umlaut consistently does not take place across a coronal consonant which has undergone secondary palatalization.

(61) Umlaut blocked by secondary palatalization

a.	/mat-i/	mac^{j}-i, *mæc^{j}-i	'the eldest'
b.	/əti/	ət^{j}i, *et^{j}i	'where'
c.	/mati/	mat^{j}i, *mæt^{j}i[9]	'knot'
d.	/mal-li/	mal^{j}-l^{j}i, *mæl^{j}-l^{j}i	'to stop'
e.	/kasi/	kas^{j}i, *kæs^{j}i	'thorn'
f.	/ənni/	ən^{j}n^{j}i, *en^{j}n^{j}i	'sister'
g.	/alli-/	al^{j}l^{j}i, *æl^{j}l^{j}i	'to inform'
h.	/kəci/	kəc^{j}i, *kec^{j}i	'beggar'
i.	/tac^{h}i-/	tac^{jh}i, *tæc^{jh}i	'to get hurt'

Since Hume's argument is based on the incorrect observation that /t/ is not (secondarily) palatalized before a tautomorphemic high front vocoid, Hume cannot explain why Umlaut is blocked across /t/ in /əti/ [ət^{j}i] (*[et^{j}i]) in (61b). We propose the following generalization as to Umlaut blocking:

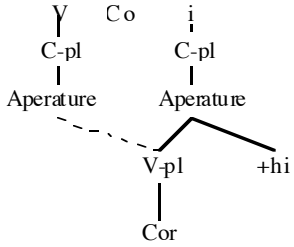
(62) Umlaut blocking
   Umlaut is blocked across a secondarily palatalized coronal consonant.

Like secondary palatalization, which was analyzed in section 5, Umlaut can also be represented as the spreading of the V-place/Cor of a high front vocoid since it forces a preceding back vowel to become a front vowel

[9]Hume 1990 says that optional umlaut takes place in /mati/ 'knot' in the Kyungsang Dialect. However, when I consulted with Kyungsang Dialect speakers, it turned out that umlaut does not take place in /mati/. Umlauted [mæt^{j}i] sounds very odd to them.

before a font high vocoid. Hence, we will represent Umlaut as spreading of the V-place of a high front vocoid to a preceding back vowel.

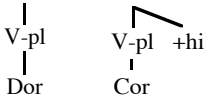
(63) Umlaut



We conclude that Umlaut and secondary palatalization are the same phenomenon. The only difference between Umlaut and secondary palatalization is that the V-place of a high front vowel spreads to a back vowel in Umlaut but it spreads to a coronal consonant in secondary palatalization.

To explain the necessity of Umlaut, we further propose the following constraint, which does not allow a surface sequence of a back vowel and a high front vocoid.

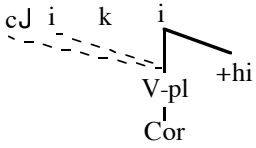
(64) *V Co V (henceforth, *DOR-C0-COR)



A sequence of a back vowel and a high front vocoid is not allowed.

As shown in section 1, primary palatalization is a strictly local phenomenon and only a coronal consonant and a following high front vocoid are involved in primary palatalization. And we analyzed primary palatalization in section 4 via interaction of licensing and redundancy in the sense of IMP 1993b. On the other hand, spreading of the V-place of a high front vocoid is not necessarily local (Hume 1990):

(65) /cuk-i-/ c^{j}ik-i- 'kill-Caus'

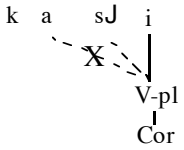


This shows that Umlaut and secondary palatalization can take place simultaneously.

On the other hand, the following examples show a case in which spreading the V-place of /i/ is blocked by secondary palatalization. According to our previous observation, Umlaut is blocked across a secondarily palatalized coronal consonant.

(66) a. /kasi/ kas^{j}i, *kæs^{j}i 'thorn'

b. /tatimi/ tat^{j}imi, *tæt^{j}imi 'fulling block'



We propose that the blocking of the spread of the V-place of a high front vocoid across a secondarily palatalized coronal consonant is due to the conspiracy of the following two constraints:

(67) a. SPREAD[$\overset{\text{V-pl}}{\underset{\text{Cor}}{|}}$][10]

[$\overset{\text{V-pl}}{\underset{\text{Cor}}{|}}$] must be multiply linked (or spread).

b. IDENT-IO[$\overset{\text{V-pl}}{\underset{\text{Cor}}{|}}$]

c. Ranking:

PAL >> SPREAD[$\overset{\text{V-pl}}{\underset{\text{Cor}}{|}}$]

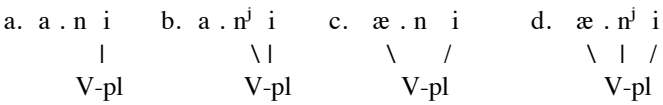
>> IDENT-IO[$\overset{\text{V-pl}}{\underset{\text{Cor}}{|}}$] >> *DOR-C0-COR

[10] I thank Young-mee Cho for suggesting this constraint.

SPREAD[F] constraint requires that a feature F be multiply linked (or spread) in the output (Padgett 1995 and others). SPREAD[$\overset{\text{V-pl}}{\text{Cor}}$] forces [$\overset{\text{V-pl}}{\text{Cor}}$] to be multiply linked. However, spreading the feature [$\overset{\text{V-pl}}{\text{Cor}}$] to a preceding segment compels violation of lower ranked IDENT-IO[$\overset{\text{V-pl}}{\text{Cor}}$].

The basic concept of the proposed constraint ranking is as follows. Consider the following potential candidates, given the input /ani/:

(68) /ani/ [an^{j}i] 'no'



Candidate (a) violates high ranked PAL and SPREAD[$\overset{\text{V-pl}}{\text{Cor}}$]. And it also violates lowest ranked *DOR-C0-COR due to lack of Umlaut. Candidate (b) receives one violation mark for IDENT-IO[$\overset{\text{V-pl}}{\text{Cor}}$], which is compelled to avoid violation of SPREAD[$\overset{\text{V-pl}}{\text{Cor}}$] and PAL. It also violates lower ranked *DOR-C0-COR due to lack of Umlaut. In this case, spreading of [$\overset{\text{V-pl}}{\text{Cor}}$] of /i/ to /n/ satisfies higher ranked PAL and SPREAD[$\overset{\text{V-pl}}{\text{Cor}}$]. Candidate (c) is worse than candidate (b) since it violates higher ranked PAL. It also receives one violation mark for IDENT-IO[$\overset{\text{V-pl}}{\text{Cor}}$], which is compelled to avoid violation of SPREAD[$\overset{\text{V-pl}}{\text{Cor}}$]. Candidate (d) is also worse than candidate (b) since it receives two violation marks for IDENT-IO[$\overset{\text{V-pl}}{\text{Cor}}$] in comparison with one violation mark for IDENT-IO[$\overset{\text{V-pl}}{\text{Cor}}$] in candidate (b). As a result, the best of the worst candidates is candidate (b).

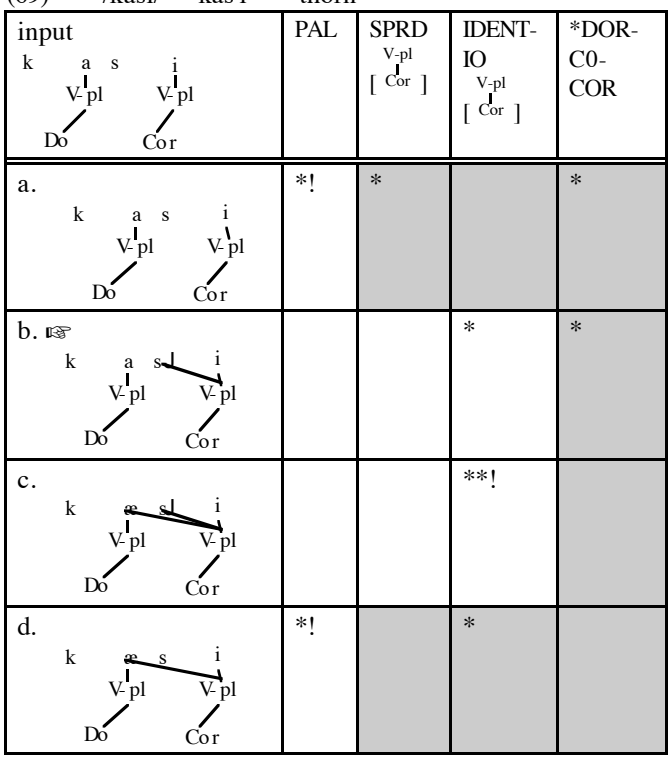
Hence, the effect of the ranking SPREAD[$\overset{\text{V-pl}}{\text{Cor}}$] >> IDENT-IO[$\overset{\text{V-pl}}{\text{Cor}}$] is to force spreading of [$\overset{\text{V-pl}}{\text{Cor}}$] of a high front vocoid (to a neighboring segment) to occur only once, unless the resulting configuration violates other

higher ranked constraints such as PAL (in the case of multiple spreading of [$^{V\text{-}pl}_{Cor}$] (see the tableau in (71) for the multiple spreading case)).

The following tableau illustrates how the constraint ranking predicts that Umlaut is blocked across a secondarily palatalized consonant:

(69) /kasi/ kas^{j}i 'thorn'

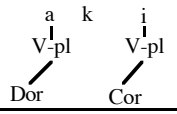
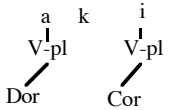
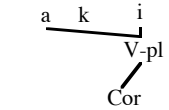
input	PAL	SPRD [$^{V\text{-}pl}_{Cor}$]	IDENT-IO [$^{V\text{-}pl}_{Cor}$]	*DOR-C0-COR
a.	*!	*		*
b. ☞			*	*
c.			**!	
d.	*!		*	



Candidates (a) and (d) fatally violate PAL. Candidate (b) receives one violation mark for IDENT-IO[$^{V\text{-}pl}_{Cor}$] and another violation mark for lower ranked *DOR-C0-COR. However, candidate (c) receives two violation marks for IDENT-IO[$^{V\text{-}pl}_{Cor}$]. As a result, candidate (c) is optimal.

The following tableau illustrates a case in which Umlaut occurs across a non-coronal consonant:

(70) /aki/ æki (or aki) 'baby'

input	SPRD [V-pl Cor]	IDENT-IO [V-pl Cor]	*DOR-C0-COR
			
a. 	*!		*
b. ☞ 		*	

In the tableau above, candidate (a) fatally violates SPREAD[$^{\text{V-pl}}_{\text{Cor}}$]. However, candidate (b) violates lower ranked IDENT-IO[$^{\text{V-pl}}_{\text{Cor}}$] and is optimal.

The following is a case of Umlaut plus secondary palatalization, in which spreading of the V-place of /i/ is not limited to a neighboring consonant or vowel:

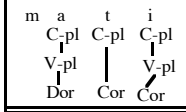
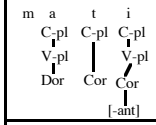
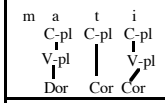
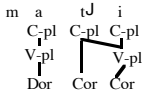
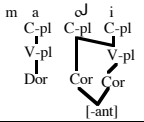
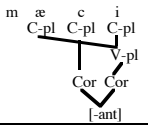
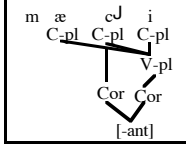
(71) /cuk-i-/ cʲik-i- 'kill'

input	PAL	SPRD V-pl [Cor]	IDENT-IO V-pl [Cor]	*DOR-C0-COR
a.		*!		*
b.	*!		*	
c. ☞			**	

Candidate (b) is eliminated due to fatal violation of undominated PAL. Candidate (a) receives a fatal violation mark for SPREAD[$^{\text{V-pl}}_{\text{Cor}}$] whereas candidate (c) receives two violation marks for lower ranked IDENT-IO[$^{\text{V-pl}}_{\text{Cor}}$]. As a result, candidate (c) is optimal. This tableau shows that multiple spreading of [$^{\text{V-pl}}_{\text{Cor}}$] must take place to avoid violation of highly ranked PAL. Otherwise, the ranking SPREAD[$^{\text{V-pl}}_{\text{Cor}}$] >> IDENT-IO[$^{\text{V-pl}}_{\text{Cor}}$] would require that spreading of [$^{\text{V-pl}}_{\text{Cor}}$] occur only once, as shown early in this section.

We will show a case in which palatalization-blocking of Umlaut takes place across a derived palatal which has also undergone secondary palatalization.

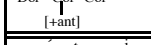
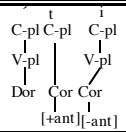
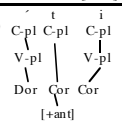
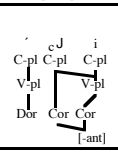
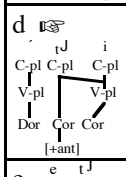
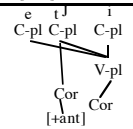
(72) /mat-i/ mac^{j}-i 'the eldest'

input 	PAL	Licen [-ant]	SPRD V-pl [Cor]	IDENT-IO V-pl [Cor]	*DOR-C0-COR	FRON-HI [-ant]
a 	*!	*	*		*	
b 	*!		*		*	*
c 				*	*	*!
d ☞ 				*	*	
e 	*!			*		
f 				**!		

Candidates (a), (b) and (e) are eliminated by a violation mark for undominated PAL, which forces a coronal consonant and a following high front vowel to share the V-place. Candidate (f) receives two violation marks for SPREAD[$\overset{\text{V-pl}}{|}$ Cor] in comparison with candidates (c) and (d), which receive one violation mark for the same constraint. Candidate (d) is preferred as optimal over candidate (c) since candidate (c) additionally violates FRON-HI [-ant].

Finally, consider the following tableau, in which Umlaut is blocked across the secondarily palatalized [tʲ]. Note that /t/ before a tautomorphemic /i/ is prespecified for [+ant] and is realized as secondarily palatalized [tʲ].

(73) /əti/ ətʲi 'where'

input	LICEN [-ant]	IDENT-IO [+ant]	PAL	SPRD V-pl [Cor]	IDENT-IO V-pl [Cor]	*DOR-C0-COR	FRON-HI [-ant]
							
a 	*!		*	*		*	
b 			*!	*		*	*
c 		*!			*	*	
d ☞ 					*	*	*
e 					**!		*

Candidates (a), (b) and (c) are eliminated due to at least one violation mark for a highly ranked constraint. On the other hand, candidate (d) is preferred over candidate (e) since the former receives one violation mark for IDENT-IO[$\overset{\text{V-pl}}{\underset{|}{\text{Cor}}}$] whereas the latter, two violation marks for the same constraint.

In this section, we have proposed the following constraint ranking:

(74) Constraint ranking in the Kyungsang Dialect

SPREAD[$\overset{\text{V-pl}}{\underset{|}{\text{Cor}}}$]

>> IDENT-IO[$\overset{\text{V-pl}}{\underset{|}{\text{Cor}}}$]

>>*DOR-Co-COR, FRON-HI[-ant]

7. Summary

We have shown that phonemic primary /t/-palatalization, which is treated as a prototypical case of non-derived environment effect in the framework of Lexical Phonology in the literature, is an independent phenomenon from allophonic secondary palatalization in Korean. Furthermore, we showed that a paradox which arises in the lexical and postlexical dichotomy in LP in the analysis of primary and secondary palatalization can be eliminated in an OT-based approach. We analyzed primary palatalization through interaction between licensing and redundancy of the feature [-ant] in the sense of IMP 1993b. We additionally argued that palatal blocking of Umlaut in Korean is due to secondary palatalization alone, unlike the arguments in the literature which claim that palatal blocking of Umlaut is due to both primary and secondary palatalization. Following Kiparsky, we reintroduced the idea that morpheme-internal idiosyncratic /t/ before /i/ should be underlyingly specified for a "redundant" [+anterior] to explain lack of primary palatalization in the morpheme-internal /ti/ sequence.

In the analysis of Umlaut, we analyzed Umlaut as the same phenomenon as secondary palatalization (i.e., spreading of the V-place of a high front vocoid). Furthermore, we attributed blocking of Umlaut across a secondarily palatalized coronal consonant to the conspiracy of the two constraints SPREAD[$\overset{\text{V-pl}}{\underset{|}{\text{Cor}}}$] and IDENT-IO[$\overset{\text{V-pl}}{\underset{|}{\text{Cor}}}$].

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